III. Dioxin and Polyvinyl Chloride

The term "dioxin" refers to a group of chemical compounds that share certain similar chemical characteristics and common mechanisms of toxicity. Dioxin is created as an unintended by-product of a reaction of chlorine and organic molecules in a process such as incomplete combustion or as a contaminant in chemical manufacturing processes. Although dioxin is released into the environment in small quantities, it builds up in soil, sediment and plants, bioaccumulates in animal and fish tissue, and is passed up the food chain to people. Dioxin also bioaccumulates in a woman's body and is passed to her infant through breast milk.

Dioxins modulate and disrupt growth factors, hormones, enzymes and developmental processes. Additionally, both animal and human epidemiological studies conclude that dioxin is toxic to the developing immune system and is a known human carcinogen.

- Dioxin, PVC and Health Care Institutions
  Section 3-1 of *Going Green*
  www.noharm.org/library/docs/Going_Green_3-1_Dioxin_PVC_and_Health_Care.pdf

- How To Start To Stop Dioxin Exposure In Your Community
  www.noharm.org/library/docs/Stop_Dioxin_Exposure.htm

New Hampshire's *Dioxin Reduction Strategy*

As part of its continuing efforts to address persistent bioaccumulative toxics (PBTs), DES began an initiative to substantially reduce dioxin contamination in New Hampshire's environment. In March 2001, New Hampshire adopted the first-in-the-nation strategy developed by DES to substantially reduce harmful dioxin emissions in the state. *The New Hampshire Dioxin Reduction Strategy* (February 2001) recommends actions that are expected to cut dioxin emissions from a variety of sources in half by 2003.

Some of the recommended actions for hospitals still operating medical waste incinerators (or those facilities that incinerate their waste) include the virtual elimination of all PVC-containing products from the medical waste stream by 2005. The strategy also calls for phasing out the operation of all medical waste incinerators in the state by 2010. Other recommended actions include the promotion of environmentally safer methods of medical waste management, such as reducing the use of chlorine-containing products that emit dioxins when incinerated and using alternative disposal methods such as sterilization. The *Strategy* also calls for legislation to be drafted that would prohibit the disposal of PVC-containing products in medical waste incinerators. To see a full copy of the *Strategy*, visit www.des.state.nh.us/ard/dioxin/strategy.pdf.

At the time the *Dioxin Strategy* was published, DES estimated that HMIWIs operating in New Hampshire produced almost 29 percent of the state's total dioxin emissions. This is higher than the national average, estimated in 1995, when HMIWIs were estimated to produce 11.5 percent of the nation's total dioxin emissions. Since April 2001, the percentage of dioxin emissions in New Hampshire generated by hospital incinerators has decreased because a number of incinerators have closed. It must be kept in mind, however, that most infectious waste generated by healthcare facilities is shipped out of state where it is still incinerated.

PVC Use

PVC plastic is a major source of chlorine in the medical waste stream and can lead directly to increased dioxin emissions from incinerators. PVC plastics can contain up to 57 percent chlorine by weight. Since PVC is more than 50 percent chlorine by weight, it is a major precursor (chlorine "donor") in the formation of dioxin.

PVC-containing items commonly used in healthcare include medical equipment such as IV bags, tubing, endotracheal tubes, oxygen tents, mattress covers, packaging and office supplies such as binders. PVC is also used in healthcare facility building materials, including wiring, flooring, wall coverings, pipes, etc. It is a very brittle, unstable polymer, so depending upon its intended use, many plasticizers (for flexibility and softness), stabilizers and other additives may be present. These additives do not actually bond with the PVC polymer and are subject to leaching, or breaking free, from the PVC and into the surrounding environment. Two concerns have been raised about the safety of PVC:

1) Incineration of disposed PVC products can result in the formation of dioxin.
A large body of evidence has shown a link between the amount of chlorine entering an incinerator and the dioxin emissions that leave the smokestack. PVC products contribute as much as 80 percent or more of the total chlorine fed into medical waste incinerators. The dioxin formed by these incinerators is emitted as stack gases or is contained in ash residues. For more information on alternative technologies and products, reducing your use of PVC-containing products, and medical reports and studies on DEHP, see:

- Dioxin and Related Compounds
  cfpub.epa.gov/ncea/cfm/dioxin.cfm?ActType=default

- PVC
  www.noharm.org/index.cfm?page_ID=6

- PVC
  www.sustainablehospitals.org/HTMLSrc/IP_PVC.html

2) DEHP, Di (2-ethylhexyl) phthalate, a plasticizer used in PVC products for flexibility and softness, can leach out of PVC into contained liquids such as IV fluids and internal feeding products. DEHP has been identified as a developmental and reproductive toxin.

The EPA has identified both dioxin as a known carcinogen and DEHP as probable carcinogens and possible endocrine disrupters. Studies conducted by the governments in the U.S., Canada and the European Union all conclude that exposure to DEHP is a concern. Populations most at risk include critically ill infants, healthy infants and toddlers, and pregnant and lactating women. The reports generally recommend action to reduce DEHP exposure in healthcare, particularly for the more vulnerable populations. For more information or to review these studies, see:

- Neonatal Exposure to DEHP and Opportunities for Prevention
  www.noharm.org/library/docs/Neonatal_exposure_to_DEHP_and_opportunites_for.pdf

- Weight of Evidence: DEHP Exposures are a Cause for Concern, Especially During Medical Care
  www.noharm.org/library/docs/Going_Green_3-11_The_Weight_of_Evidence_on_DEH.pdf

Reducing Polyvinyl Chloride Use

Healthcare facilities should eliminate or reduce their use of polyvinyl chloride (PVC) products wherever possible. This will reduce the amount of dioxin being incinerated. The best way to reduce PVC product use at any facility is to:

1. Take a facility-wide **inventory** of all PVC products onsite.
2. Use **source reduction** techniques to eliminate the use of PVC products where possible.
3. Properly **manage the PVC products** you cannot eliminate.

1) Inventory

PVC Products at Healthcare Facilities

PVC-containing products are commonly used in medical equipment, packaging and in hospital building materials. Products containing PVC in the hospital may include:

Basins
Bedpans
Blood Bags
Catheters
Drip Chambers
Internal Feeding Devices
Hemodialysis Equipment
IV Containers
Lab Equipment
Medical Gloves
Office Supplies
Packaging
Patient ID Bracelets
Respiratory Therapy Products
Stationary Supplies
Tubing
Thermal Blankets
Anything that contains vinyl

For more information on PVC inventory: www.sustainablehospitals.org.

2) Source Reduction

Healthcare Facilities Can Reduce the Use of PVC Products

Source reduction includes eliminating the purchase and use of chlorine-containing materials that create dioxin. As with mercury reduction, the best way to keep PVC-containing products out of the waste stream is to purchase and use products that do not contain PVC. Again, it is imperative to work with the facility's procurement group and GPO so that once the PVC products are removed from the healthcare facility, they do not come back in through the loading dock! Please refer to the paragraph on **environmentally preferable purchasing** under Source Reduction in the Mercury section of this document.

Source Reduction Techniques

Waste separation is crucial to reducing the volume and toxicity of the medical/infectious waste stream and preventing the generation of dioxin. Many materials disposed at hospitals and other medical facilities can be handled as ordinary solid waste and need not be disposed of as "red bag" or infectious waste, which will more likely be incinerated. Examples of PVC-containing items that are often red bagged, but may be solid waste, include saline IV bags and tubing, gloves, and

packaging. There is the added problem that a large volume of solid waste in N.H. is incinerated, but that problem is outside the scope of this document.

Alternative Products Are Available For Healthcare Facilities
Reducing the amount of PVC-containing material brought into a healthcare facility is by far the most effective and inexpensive way to reduce dioxin emissions. Healthcare facilities have begun to replace some of their PVC-based products and packaging with non-toxic alternatives like **non-chlorinated plastics** or **equipment that can be sterilized** and reused. Many vendors have available, or are developing, PVC-free product lines. Soft plastic tubing, bags, and containers made of chlorine-free polyethylene and polyolefin are readily available. Rigid PVC product alternatives are made of metal and non-chlorinated polypropylene or polycarbonate plastics. Ongoing research into these non-toxic alternatives will make it easier for healthcare facilities to move away from PVC containing products and packaging. If more healthcare facilities demand PVC alternatives, healthcare supply companies will respond. There are many PVC-free substitutes readily available.

The first step is to talk to the healthcare facility purchasing director to determine which PVC-free products are currently available, then talk with the GPO and suppliers to request additional alternatives. Some GPOs have taken steps towards offering alternative products. A good time to request new products is during contract negotiations.

- Alternatives to PVC and DEHP Medical Devices
  www.noharm.org/library/docs/Going_Green_3-5_PVC_Alternatives.pdf

- Alternatives to PVC Medical Products
  www.noharm.org/library/docs/Alternatives_to_PVC_Medical_Devices.htm

- List of PVC Alternative Products
  www.uml.edu/centers/LCSP/hospitals/HTMLSrc/IP_PVC.html

- Non-PVC Purchasing: A Handbook on Non-PVC Products
  cold.aaa.dk/pvc/english/index.htm

- Products for Hazard: PVC
  www.sustainablehospitals.org/cgi-bin/DB_Report.cgi?px=W&rpt=Haz&id=3

3) Proper Management
The best way to manage PVC-containing products that cannot be eliminated from the facility is to choose disposal options that do not involve incineration (provided the waste does not have to be legally incinerated). See Section IV for information on incineration and alternatives.